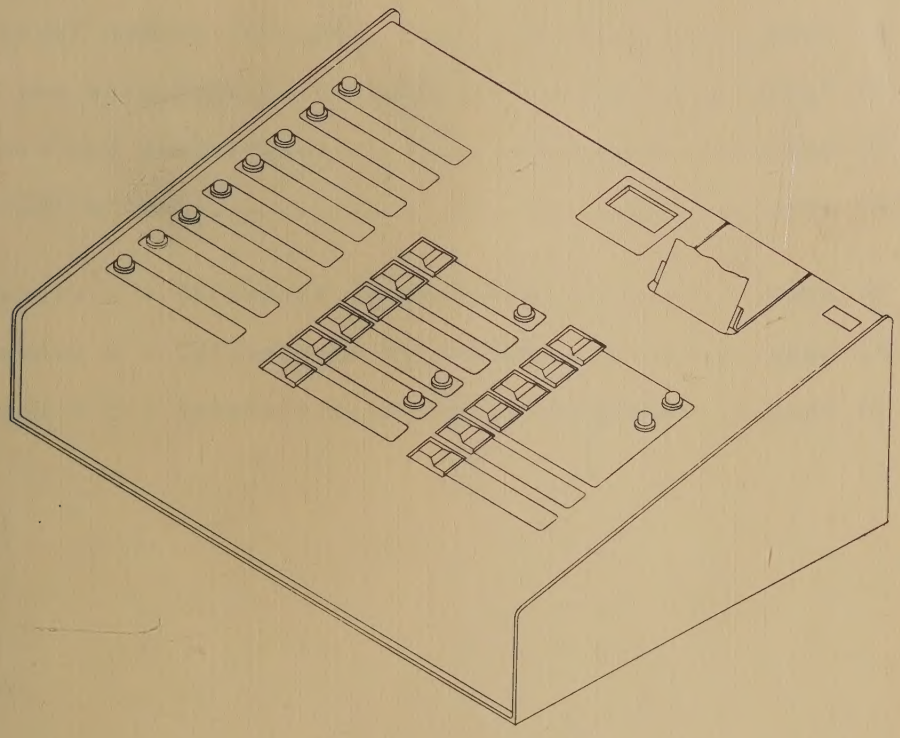
User's Manual



Model GS-2x Power Line Monitor

BMI Basic Measuring Instruments

P/N 86001237 REV. A

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BMI MODEL GS-2x

The BMI model GS-2x monitors AC power lines for common problems that can disturb or damage sensitive electronic equipment. Simply plug it into the power line to begin monitoring.

It is equipped with alarm lights, a thermal printer, an alarm beeper, an internal clock and calendar, and an internal set of rechargeable batteries that can operate the monitor during power failures.

USING THE MONITOR

Getting Started

Unpack the monitor, and plug the power cord into the socket on the back of the monitor. When new, the connector may be stiff; push it in firmly to be sure it completely seated.

Plug the monitor into the power line to be monitored. The outlet must be grounded.

The monitor does not have a power on/off switch; it is ON whenever it is plugged in. Leave it plugged in, even when not in use, to keep the batteries fully charged.

Verify that the wiring of your outlet is correct by looking at the "Phase Neutral Wiring Correct" light on the back of the unit. If the light is not on, check the wiring of the outlet in question. (If you have the monitor plugged into an isolation transformer this light will not turn on.)

Look through the filtered window labelled "Line voltage" on the front panel of the monitor. This shows the RMS voltage of the power line being monitored. (Other functions of this display will be described later.)

Press the **Print time/date** button. This will give you a report of the time and date, the line voltage, the line frequency, and the condition of the batteries.

Press the **Print thresholds** button. This will tell you what the threshold settings are for high and low voltage, power failure, voltage spike, and high and low line frequency.

Turning the Printer On and Off

Turn the printer on and off by pressing the **Printer on/off** button. You will get a printed message showing when the printer was turned on or off. If the **Printer on/off** light is on, the printer is on; the monitor will then give you a printed message whenever a power line disturbance occurs. Each message will also show the time and date that the particular disturbance occurred.

Turning the Alarm On and Off

Turn the alarm beeper on and off by pressing the **Alarm on/off** button. If the **Alarm on/off** light is on, the alarm will beep four times whenever a disturbance occurs on the power line.

Setting the Time

Pressing the **Set time** button will cause the time to be shown in the display. The **Set time** light will also turn on to acknowledge that the monitor is ready for you to change the setting of the clock.

Use the **Foward** and **Backward** buttons to adjust the setting of the clock. The display will continuously show the time as you change it. You can adjust the time quickly by holding down either the **Forward** or **Backward** buttons, or you can adjust it slowly by just tapping the buttons.

The display will automatically go back to showing the line voltage when you have completed adjusting the time.

Setting the Date

Setting the date is performed in the same manner as setting the time. Press the **Set date** button to bring the date into the front panel display. On the monitor's calendar, February always has 29 days.

If the batteries have been completely discharged, the clock/calendar is automatically set to noon onJanuary 1.

Leave the monitor plugged in, even if not in use, to keep the batteries charged. When fully charged, the batteries will operate the clock/calendar for about two weeks without external power.

The Software Revision Level

The software inside your monitor specifically defines its operation. Pressing the **Print time/date** button three times will print a message telling you what the software revision level is.

LOCKING AND UNLOCKING THE MONITOR

Locking The Monitor

The monitor's keyboard may be locked to prevent casual tampering with the controls. You can do this by pressing the **Lock** button.

When the **Lock** light is on, the front panel of the monitor is inoperable. Pressing any button at this time will make the **Lock** light flash and the buzzer beep.

Unlocking the Monitor

The monitor can be unlocked in the following manner:

First, press and hold the **Clear** button.

Second, press and hold the **Lock** button.

Third, release the **Clear** button.

Finally, release the **Lock** button. The **Lock** light will turn off, and the monitor's keyboard will be unlocked.

CHANGING THE PRINTER PAPER

Changing the Printer Paper

The printer paper needs to be changed when a red line appears along the edge of the paper. Hold the printer door open and press the **Paper advance** button to remove the remaining paper.

Remove and discard the cardboard roller from the printer.

Make sure that the edge of the new roll of paper is straight and smooth.

Feed the edge of the paper into the slot at the front of the paperholder. When fed through correctly, the edge of the paper can be seen in the small rectangular opening immediately below the small rubber roller.

Press the **Paper Advance** button until the paper comes out the front of the printer. If the paper is not being pulled off the roll, check to make sure that it was fed into the printer correctly.

SELF-TEST

Self Testing Operation

The monitor may be tested by depressing the **Self-test** button.

The self-test sequence checks the LED's, the processor, the EPROM's, the RAM, the memory interface and decode circuits, the input/output circuits, the beeper, and the alarm timing circuits.

If the self-test fails, contact the factory.

OPTIONAL SWITCH SETTINGS

The model GS-2x allows for optional settings for the power failure and power restored thresholds, line frequency tolerance, high frequency noise alarm disable, 120V or 240V operation, and phase-mode or neutral-mode spike sensing.

Power Failure/Power Restored Thresholds

These thresholds are determined by switches 1, 2, and 3 on a row of DIP switches located on the upper (digital) board. Accessing these switches requires opening up the monitor. To do this, refer to the diagrams on assembly and disassembly in Appendix C of this manual.

With the two chassis separated, set switches 1, 2, and 3 to the desired threshold according to the table below. The Power Restored threshold is automatically set to five volts above the power failure threshold.

Power Failure Threshold (120 Vrms/240 Vrms)	switch 1	switch 2	switch 3
80 Vrms/160 Vrms	**OFF**	**OFF**	**OFF**
82 Vrms/164 Vrms	**ON**	**OFF**	**OFF**
85 Vrms/170 Vrms	**OFF**	**ON**	**OFF**
87 Vrms/174 Vrms	**ON**	**ON**	**OFF**
90 Vrms/180 Vrms	**OFF**	**OFF**	**ON**
95 Vrms/190 Vrms	**ON**	**OFF**	**ON**
100 Vrms/200 Vrms	**OFF**	**ON**	**ON**
105 Vrms/210 Vrms	**ON**	**ON**	**ON**

High Frequency Noise Alarm Disable

DIP switch 6 can be used to disable the high frequency noise alarm. The monitor is normally shipped with switch 6 off. If this switch is moved to the ON position, the monitor will ignore all high frequency noise disturbances.

Line Frequency Tolerance

DIP switch 7 adjusts the line frequency tolerance. If this switch is in the ON position, wide frequency tolerance (+2Hz and -2Hz) is selected. In the OFF position the tolerance is +1Hz and -1Hz. The software automatically selects 50Hz or 60Hz operation.

120 Volt/240 Volt Operation

The GS-2x can be set up to monitor nominal line voltage levels of either 110-120 Vrms or 208-220-240 Vrms. This is controlled by setting DIP switch 8 on the upper (digital) board and setting the 120/240 slide switch on the lower (analog) board. Refer to Appendix C for the location of these switches.

For 110-120 Vrms operation, set switch 8 to the OFF position and set the 120/240 switch to 120.

For 208-220-240 Vrms operation, set switch 8 to the ON positon and set the 120/240 switch to 240. Threshold levels are automatically doubled when switch 8 is on.

To monitor power lines other than 120Vrms or 240Vrms select the setting that is closest in voltage to the line being monitored. The exact voltage thresholds can then be adjusted accordingly. (See Appendix A on THRESHOLD ADJUSTMENTS.)

Line-Mode and Neutral-Mode spike sensing

You can select between line-mode and neutral-mode spike sensing by setting the PHASE/NEUTRAL slide switch on the lower (analog) board to either PHASE or NEUTRAL respectively. The section on HOW THE MEASUREMENTS ARE MADE describes the difference between these two settings.

HOW THE MEASUREMENTS ARE MADE

VOLTAGES In order to approximate the behavior of a linear power supply, all voltage measurements are peak sense equivalents of the true RMS voltage as measured from hot to neutral (unless indicated otherwise below). Consequently, a distorted sine wave on the power line may cause a high line voltage indication, even if an RMS reading of the power line indicates that it is within the threshold. The measurement is made through a low pass filter to eliminate the effects of higher frequency transients.

POWER FAILURE The power failure measurement is made from the hot line to the neutral line. The power failure indication occurs when the peak sense equivalent drops below the power failure threshold continuously for longer than the power failure minimum duration threshold.

POWER RESTORED The power restored measurement is made from the hot line to the neutral line. The indication occurs when the peak sense equivalent rises above the power restored threshold.

HIGH LINE VOLTAGE The high line voltage measurement is made from the hot line to the neutral line. The indication occurs when the peak sense equivalent rises above the high line threshold continuously for longer than the high line voltage minimum duration threshold.

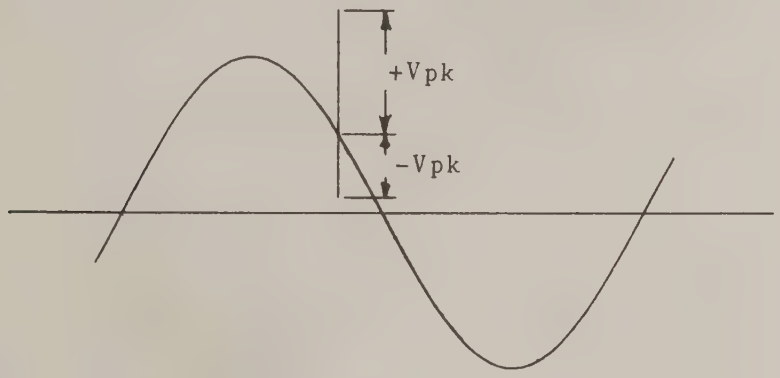
LOW LINE VOLTAGE The low line voltage measurement is made from the hot line to the neutral line. The indication occurs when the peak sense equivalent drops below the low line voltage threshold continuously for longer than the low line voltage minimum duration threshold.

VOLTAGE SPIKE The voltage spike measurement is made from the hot line to ground when sensing in the PHASE-mode and from the neutral line to ground when sensing in the NEUTRAL-mode. The mode is switch selectable. (See the section on OPTIONAL SWITCH SETTINGS.)

The amplitude of a voltage spike is measured as the peak voltage deviation from the normal position along the power sine wave. In the diagram on the next page, the positive portion of the voltage spike disturbance is +Vpk and the negative portion is -Vpk.

The monitor will evaluate both the positive and negative portions of a voltage spike disturbance and use the larger of the two values.

In this example, +Vpk is larger in magnitude than -Vpk. Thus if the monitor found +Vpk to be greater than the voltage spike threshold, a voltage spike indication would be reported.



VOLTAGE DROP The voltage drop measurement is made from the hot line to the neutral line. The amplitude and timing thresholds are set by trimpots on the bottom of the monitor. The indication occurs when the peak sense equivalent drops below the voltage drop threshold continuously for longer than the voltage drop minimum duration threshold.

HIGH FREQUENCY NOISE The high frequency noise measurement is made from the hot line to the ground line when sensing in the PHASE-mode and from the neutral line to the ground line when sensing in the NEUTRAL-mode. The alarm indication occurs when the peak-to-peak noise superimposed on the power sine wave exceeds the high frequency noise threshold continuously for longer than the high frequency noise minimum duration. The measurement is made through a high pass filter.

LINE FREQUENCY The line frequency measurements are made from the hot line to the neutral line. The line frequency is determined by timing two successive zero-crossings of the sine wave. The line frequency is sampled at times determined by the processor (approximately eight times per second, except when printing). The high line frequency indication and the low line frequency indication occur when four successive samplings of the zero crossing time indicate high or low line frequency.

CAUSES AND SOLUTIONS

There are many common causes of and potential solutions to the power disturbances reported by the GS-2x power line monitor. The types of equipment that correct power line problems vary widely and are often specifically geared toward a particular problem. The information provided by the monitor should be studied carefully before investing in corrective equipment so that an appropriate and cost effective solution can be reached.

POWER FAILURE

Possible causes:
Monitor was unplugged. Circuit breaker tripped. Power distribution failure. Utlity failure.

Possible solutions:
Isolate circuit breaker. Circuit breaker with higher rating or consider rewiring. Place label on circuit breaker marked "Do not turn off". Consider battery backup for semiconductor memory with auto-start hardware and appropriate recovery software. Uninterruptible power supply (UPS).

LOW LINE VOLTAGE

Possible causes:
Overloaded power circuit. Starting of a large, heavily loaded motor. Switching of power mains (internal or external). Addition of heavy load to destributin network. Utility power failure. Intentional utility "brown-out".

Possible solutions:
Isolate cicuit breaker. Install voltage regulating transformer or ferroresonant transformer.

HIGH LINE VOLTAGE

Possible causes:
Mistake in power wiring. Utility error. Internal power generation from heavy equipment.

Possible solutions:
Correct power wiring. Install voltage regulating transformer or ferroresonant transformer.

VOLTAGE SPIKE

Possible causes:
Switching inductive load. Static. Lightning.

Possible solutions:
Install high isolation transformer or spike suppressor.

CAUSES AND SOLUTIONS (continued)

VOLTAGE DROP

Possible causes:
Starting of a large, heavily loaded motor. Switching of power mains (internal or utility). Addition of heavy load to distribution network. Utility error.

Possible solutions:
Install ferroresonant transformer or UPS.

HIGH FREQUENCY NOISE

Possible causes:
Electric motors. Amateur or commercial radio broadcast. Arcing contacts, or other sparks. Power line communication devices.

Possible solutions:
Install line filters or high isolation transformer. Isolate power line.

LINE FREQUENCY ERRORS

Possible causes:
Incorrect setting of motor-generator. Power failure. Switching power factor correction capacitors.

Possible solutions:
Correct setting. Faster line voltage regulation.

SPECIFICATIONS

Line Voltage:

120 Vrms nominal
Switch selectable to 240 Vrms nominal

Line voltage measurement:
Range: 80 Vrms - 140 Vrms (120 Vrms operation)
160 Vrms - 280 Vrms (240 Vrms operation)
Accuracy: +/- 1.5%

Low line voltage threshold:
Standard factory setting: 105 Vrms
Internally adjustable, 80 Vrms - 140Vrms (120Vrms operation)
Internally adjustable, 160 Vrms - 280 Vrms (240 Vrms operation)
Response: 100ms

High line voltage threshold:
Standard factory setting: 125 Vrms
Internally adjustable, 80 Vrms - 140 Vrms (120 Vrms operation)
Internally adjustable, 160 Vrms - 280 Vrms (240 Vrms operation)
Response: 100ms

Voltage Spike:

Voltage spike measurement:
Range: -600 Vpk to +600 Vpk
Accuracy: +/- 10%

Voltage spike threshold:
Standard factory setting: 100 Vpk
Internally adjustable, 32 Vpk to 286 Vpk
Response: 5 us to stated accuracy. Useful response down to 500 ns.

Line Frequency:

Nominal operating frequencies: 50Hz, 60Hz (automatic internal selection)
Thresholds: +2Hz and -2Hz nominal operating frequency. Switch selectable to +1Hz and -1Hz nominal operating frequency. (See OPTIONAL SWITCH SETTINGS.)
Accuracy: +/-0.5Hz
Response: 500ms

High Frequency Noise:

More than 2 V pk-to-pk +/- 10% for more than 50 ms +/-10% at 100KHz. Usable response from 25 KHz to 2MHz. Switch selectable line-to-ground sensing (phase-mode) or line-to-neutral sensing (neutral-mode).
Range: 1.5V to 8V pk-to-pk (See CALIBRATION ADJUSTMENTS)

SPECIFICATIONS (continued)

Voltage Drop:

Threshold: 70 Vrms - 140 Vrms (120 Vrms operation)
140 Vrms - 280 Vrms (240 Vrms operation)
See Appendix B on CALIBRATION ADJUSTMENTS
Accuracy: +/- 10%
Response: 10ms - 25ms (adjustable - see Appendix B on CALIBRATION ADJUSTMENTS)
Standard factory settings: 80 Vrms for 20ms

Power Failure:

Range: 80 Vrms - 105 Vrms (120 Vrms operation)
160 Vrms - 210 Vrms (240 Vrms operation)
Switch selectable (see OPTIONAL SWITCH SETTINGS)
Accuracy: +/- 5%
Response: 500 mS
Standard factory threshold: 90 Vrms

Power Restored:

Range: 5 Vrms above Power Failure threshold
Accuracy: +/- 5%
Response: 50 mS

Printing:

Black thermal printing (can be duplicated on an office copier), 14 columns

Clock/Calendar:

Supported by internal, rechargeable Nickel-Cadmium batteries for 2 weeks minimum without line power when batteries are fully charged.

Spare battery packs available from the factory

Operating Conditions:

32 F to 128 F (0 C TO 52 C), 10 - 90% RH non-condensing

Physical:

Monitor: 10" x 7" x 4", 7 lbs
Temperature probe: 2" x 1" x 1", 8 ozs., 10 foot cable

Notes:

1. All Vrms specifications are sine peak-sense equivalent.
2. The voltage spike and high frequency noise measurements can be made from line to ground or neutral to ground (switch selectable).
3. The line frequency measurement is made by timing successive zero crossings of the power sine waves. It is sampled approximately eight times per second.
4. Monitors are calibrated at the factory for 120Vrms unless otherwise requested.

Appendix A

THRESHOLD ADJUSTMENTS

Printing the Thresholds

Before adjusting any thresholds check the present threshold settings by pressing the **Print Thresholds** button. The monitor will print out the setting of each of the six thresholds.

Adjusting the thresholds

The threshold adjustment trimpots are inside the GS-2x monitor and adjusting these thresholds requires opening up the unit. This should be done by qualified personnel with the power disconnected. Refer to the assembly and disassembly diagrams in Appendix C of this manual.

With the two chassis separated, stand the chassis up on their sides. Make sure that both interconnect cables are properly connected.

Now reconnect power to the unit; it should power up normally. Disconnect the power immediately if it does not, and visually inspect the internal connections.

Make sure the monitor is unlocked before adjusting any of the thresholds. The **Lock** light should be off. If the unit is locked, unlock it by following the instructions in the section LOCKING AND UNLOCKING THE MONITOR. Also check that the printer is turned off.

The threshold adjustment trimpots are located on the upper (digital) board next to the printer assembly. Refer to the diagrams in Appendix C to determine where the particular trimpots are positioned.

The display normally shows the power line voltage. When one of the three threshold adjustment trimpots are turned, the display automatically changes to showing the new setting of the adjusted threshold. While viewing the display, adjust the particular threshold to the desired value. The display will go back to showing the line voltage after approximately five seconds.

When you have completed adjusting the thresholds, disconnect power as before and reassemble the monitor in the same manner that you disassembled it.

Print the thresholds again to ensure proper settings. Threshold adjustment is now complete.

Appendix B

CALIBRATION ADJUSTMENTS

Equipment required

Calibration of the monitor should be checked periodically. In order to check the calibration you will need the following equipment:

1. Digital true RMS volt meter
2. Oscilloscope
3. Power Line Spike Generator (EITEL model 3020 Line Noise Generator or equivalent)
4. Line noise generator, 100KHz, 2V pk-to-pk
5. Squarewave generator, 5V pk-to-pk minimum
6. Variable line voltage transformer
7. Small slotted screwdriver

Accessing the Adjustment Trimpots

If any calibration adjustments are necessary you will need to remove the calibration seal on the bottom of the monitor to expose the trimpots. The description next to the trimpots indicates which trimpot to adjust. Removing the calibration seal will not void your warranty.

Getting into Calibration Mode

To perform the calibrations, the monitor must be put in the calibration mode. Press the **Print thresholds** button three times. The monitor will respond by printing out "--CALIB MODE--"; the next line will read "LINE VOLTAGE". The line voltage is now ready to be calibrated.

When in the calibration mode, the **Forward** button moves the calibration field to the next position. Use the **Clear** button to leave the calibration mode.

Performing the Calibrations

Line Voltage Calibration

While in the "LINE VOLTAGE" field, the display underneath the red window continuously reads the line voltage.

Set up the voltmeter to measure RMS voltage. Directly measure the voltage of the power line from line to neutral. (If your meter has a nulling feature, make sure you null the meter before taking the measurement.)

If this measurement does not agree with the reading in the display adjust the trimpot labelled "AC voltage calibration" on the bottom of the monitor. This is done by turning the trimpot with a screwdriver until the two measurements agree. Calibration of the line voltage will then be complete.

Positive Voltage Spike Calibration

This calibration procedure requires the monitor to be connected to the EITEL model 3020 line noise generator.

Press the **Forward** button to access the spike calibration field. The printer will read "POS SPIKE".

Using the line noise generator, generate repeated positive spikes of 200Vpk. The peak voltage of the spikes should be measured using an oscilloscope and with the oscilloscope lead connected directly to the "hot" or line conductor at the output of the line noise generator. If the display does not read "200", adjust the "AC spike calibration" trimpot.

Negative Voltage Spike Calibration

Press the **Forward** button. The printer should read "NEG SPIKE".

In the manner described above, generate repeated negative spikes of 200Vpk. The display should read "200". This calibration adjustment is made inside the monitor. It is done by turning trimpot R103 on the lower (analog) circuit board until the display reads "200". This adjustment should only be made after the positive voltage spike measurement is calibrated. Refer to the GS-2x assembly and disassembly diagrams in appendix C of this manual if adjustment trimpot is required.

Voltage Drop Threshold Calibration

This calibration procedure requires the monitor to be plugged into a variable line voltage transformer.

Press the **Forward** button. The printer will read "VOLTAGE DROP./HIGH FRQ NOISE".

Using the line voltage transformer, bring the line voltage down to the desired voltage drop threshold. (The line voltage should be measured with a digital true RMS voltmeter.)

Carefully adjust the "Voltage drop threshold calibration" trimpot until the **Voltage drop** alarm light just turns on.

If the **Voltage drop** alarm light will not turn off at all, turn the "Voltage drop timing calibration" trimpot fully clockwise and repeat the above procedure. If the alarm light still will not turn off or if it will not turn on at all, the line voltage is probably out of range of the voltage drop threshold.

The voltage drop threshold is now calibrated; adjust the line voltage back to the nominal value.

Voltage Drop Timing Calibration

The voltage drop timing calibration procedure requires a square wave generator to be connected to the lower board inside the monitor. Refer to the diagrams in appendix C of this manual before opening up the monitor.

The monitor should still be in the "VOLTAGE DROP./HIGH FRQ NOISE" calibration field.

To calibrate the timing, set up the wave generator to provide a 5V pk-to-pk, 40Hz square wave. Greater than 5V pk-to-pk could cause permanent damage to the monitor.

Make sure the negative end of the square wave output is referenced to ground. If it is not already referenced to ground and is floating, it can be referenced by connecting the negative end of the square wave output to the "GROUND" test point on the lower (analog) board. Refer to Appendix C for the specific location of this test point.

Open switch S7 on the lower (analog) board by lifting it up. Connect the square wave (positive) output to test point TP1. Monitor test point TP2 with an oscilloscope. (Refer to Appendix C for the exact location of the switch and test points.)

Once each cycle of the square wave input, the voltage level at test point TP2 will go low for a period of time specified as the voltage drop duration. (This is nominally set to 20ms at the factory.) You need to turn the "Voltage drop timing calibration" trimpot to adjust this to the desired duration (e.g. 20ms).

Remember to close switch S7 after having completed this calibration procedure.

High Frequency Noise Calibration

The monitor should still be in the "VOLTAGE DROP./HIGH FRQ NOISE" calibration field.

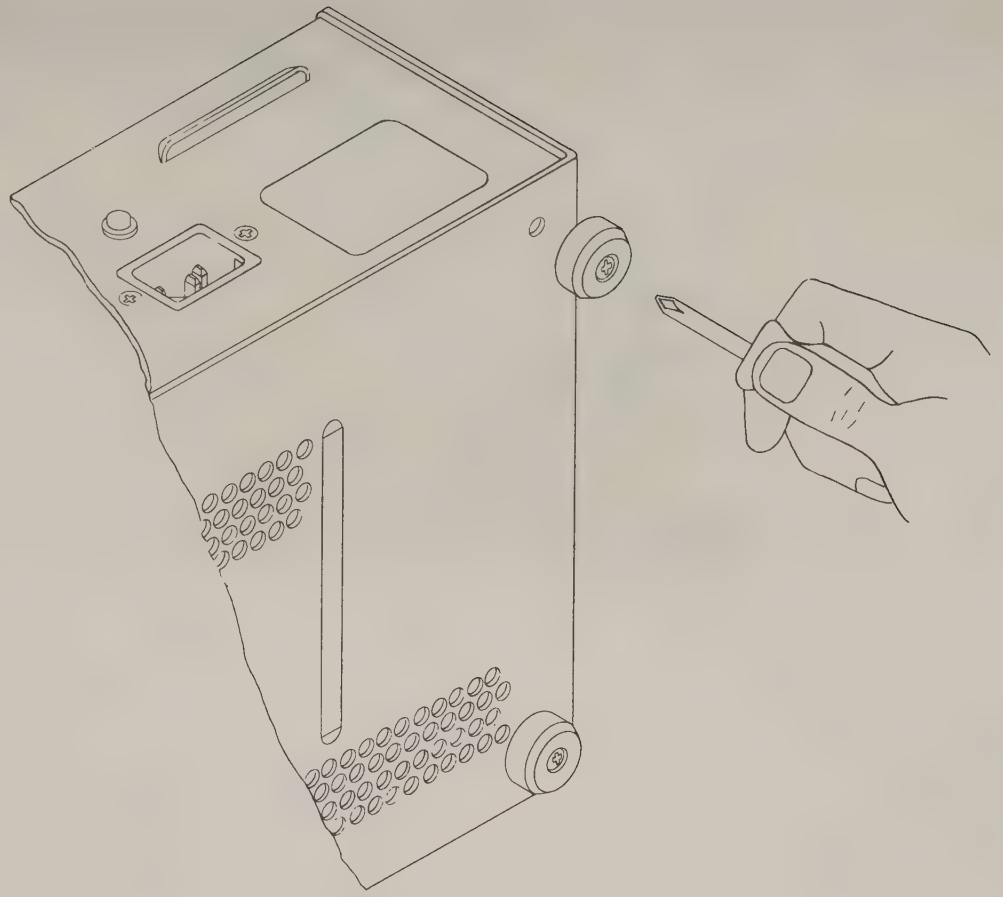
Begin calibration by turning the "High freq. noise threshold calibration" trimpot fully clockwise. Using the line noise generator, apply a 100KHz waveform superimposed on the power line. Set the peak-to-peak voltage of the line noise to the desired peak-to-peak voltage threshold (e.g. 2 Vpk-to-pk).

Carefully turn the calibration trimpot counter-clockwise until the **High frequency noise** alarm light just turns on. If the alarm light will not turn on at all or turns on but will not turn off, you are probably outside the range for high frequency noise threshold. (See SPECIFICATIONS section for this range.)

The high frequency noise threshold is now calibrated.

Appendix C

ASSEMBLY AND DISASSEMBLY DIAGRAMS



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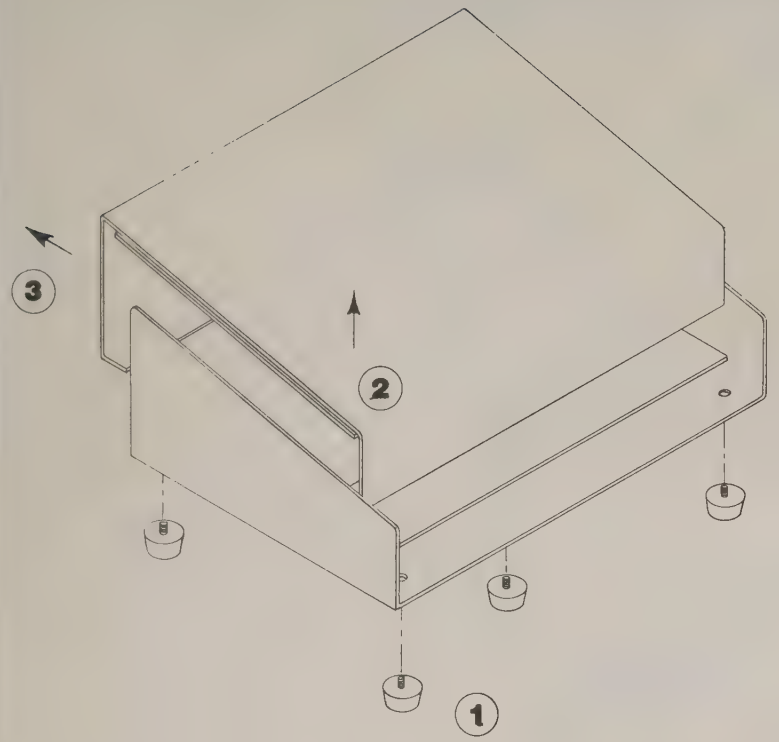

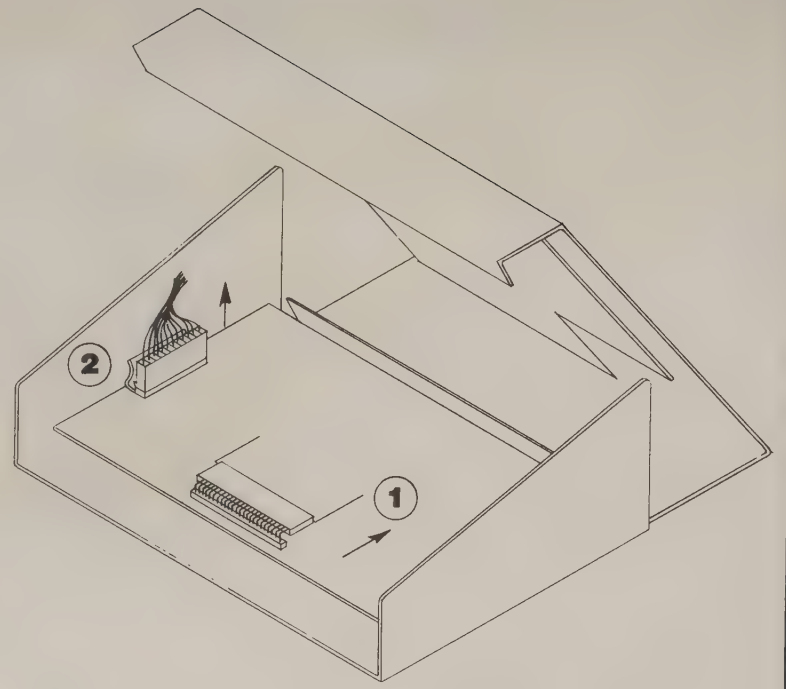

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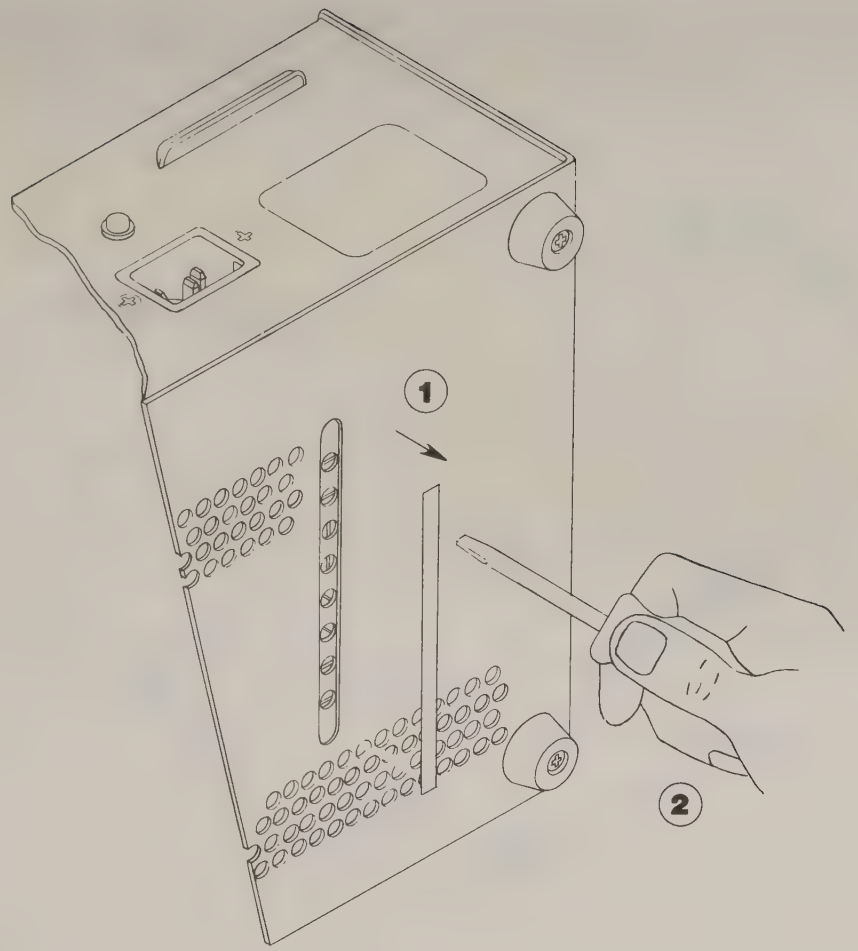

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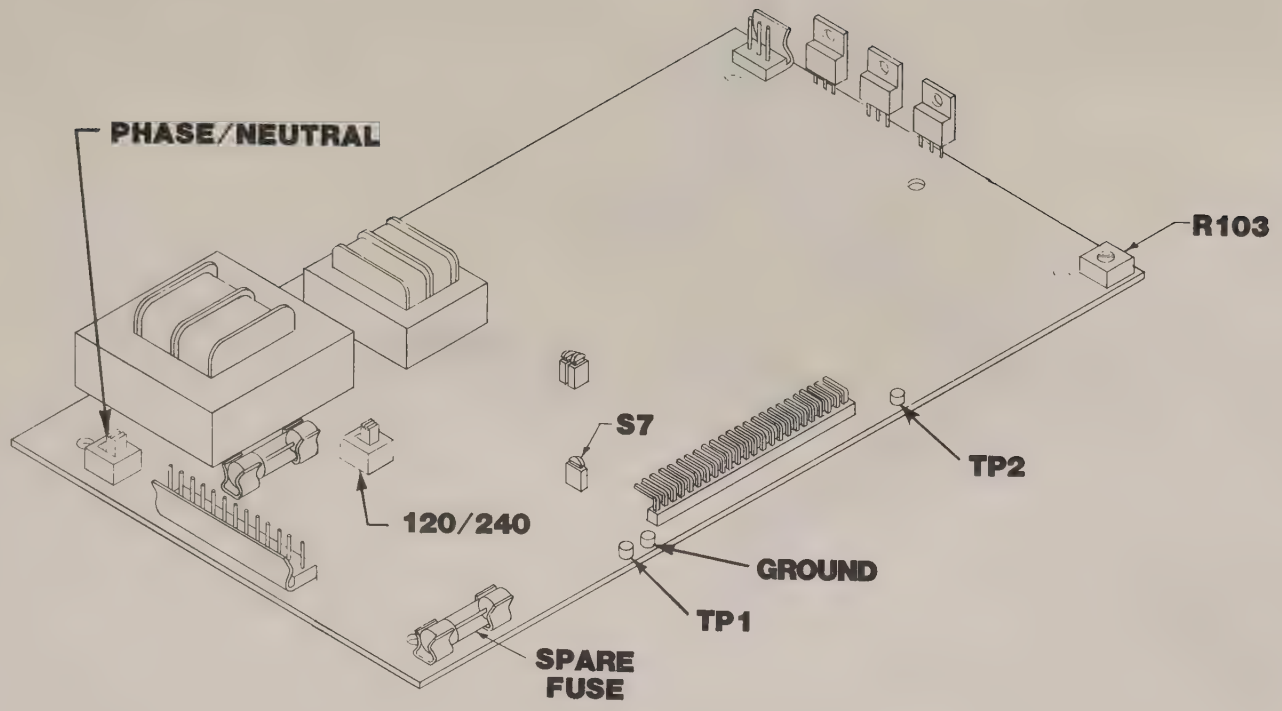

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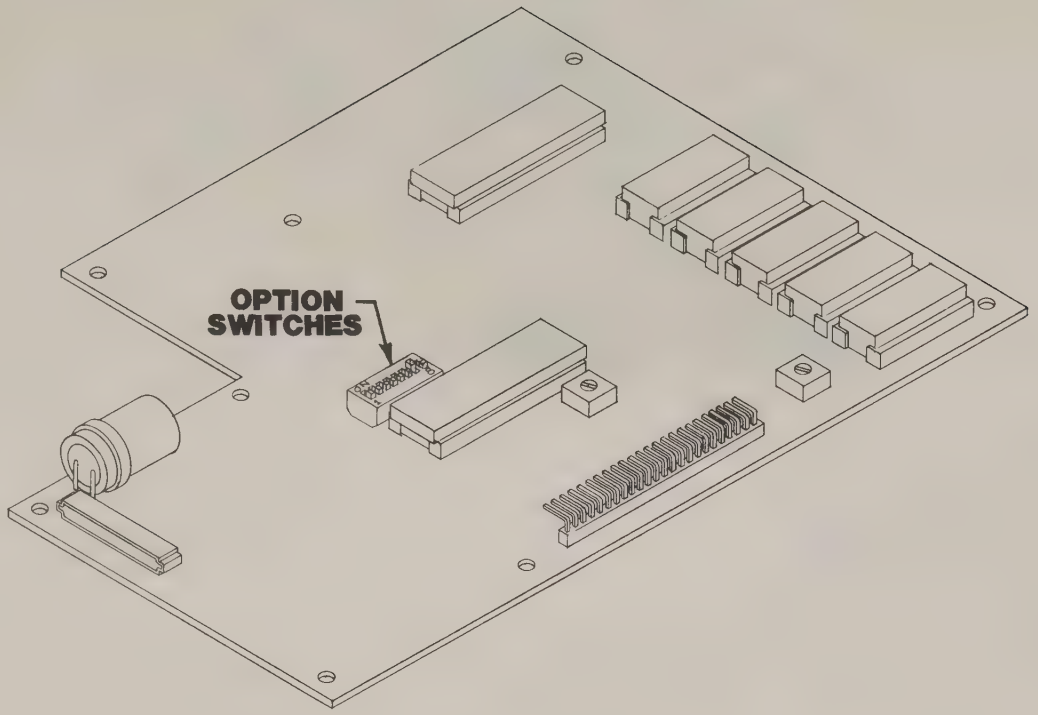
APPLICATION		DO NOT SCALE DRAWING		

BISHOP GRAPHICS INC.
REORDER NO. 1950



		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES XX ± XXX ±	CONTRACT NO.	BMI BASIC MEASURING INSTRUMENTS	
			APPROVALS DATE	ILLUSTRATION	
			DRAWN G.P.S. 3-5-84	DIGITAL BOARD	
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		FINISH		SIZE C / CODE IDENT NO / DRAWING NO 86001134 / REV. A	
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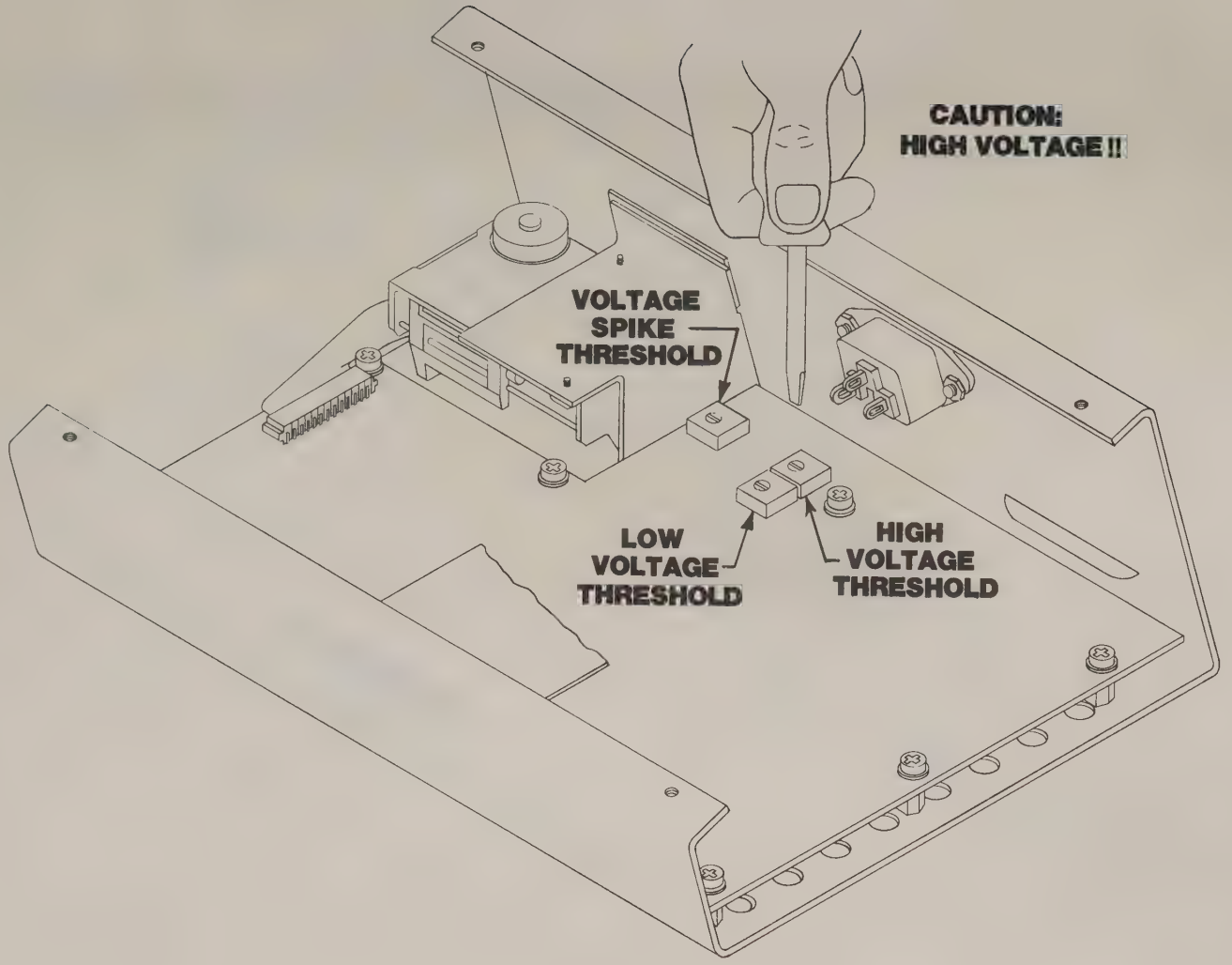
APPLICATION		DO NOT SCALE DRAWING		SCALE 1 TO 1	SHEET 1 OF 1

B SHOP GRAPHICS, INC
RECORD # NO. 1850



		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES + XX + - XXX ±	CONTRACT NO	BMI BASIC MEASURING INSTRUMENTS
			APPROVALS DATE	ILLUSTRATION
			DRAWN G.P.S.	THRESHOLD ADJUSTMENT GS-2x
		MATERIAL	CHECKED	
		FINISH	SIZE C / CODE IDENT NO / DRAWING NO 86001146 / REV. A	
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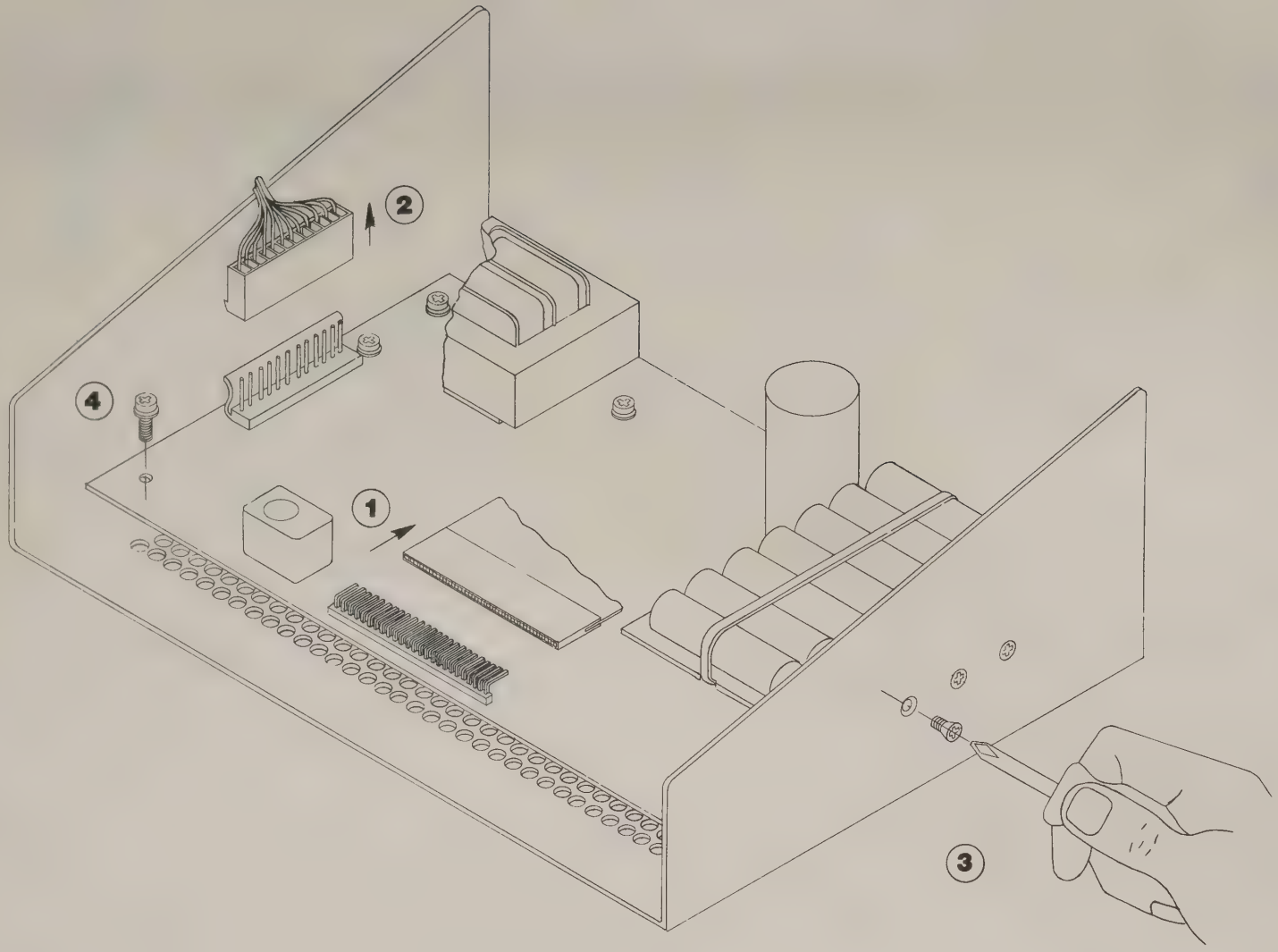
APPLICATION		DO NOT SCALE DRAWING		

BISHOP GRAPHICS, INC
REORDER NO. 1850



		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:	CONTRACT NO	BMI BASIC MEASURING INSTRUMENTS	
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		MATERIAL	CHECKED		
		FINISH			SIZE C · CODE IDENT NO · DRAWING NO 86001126 · REV. A
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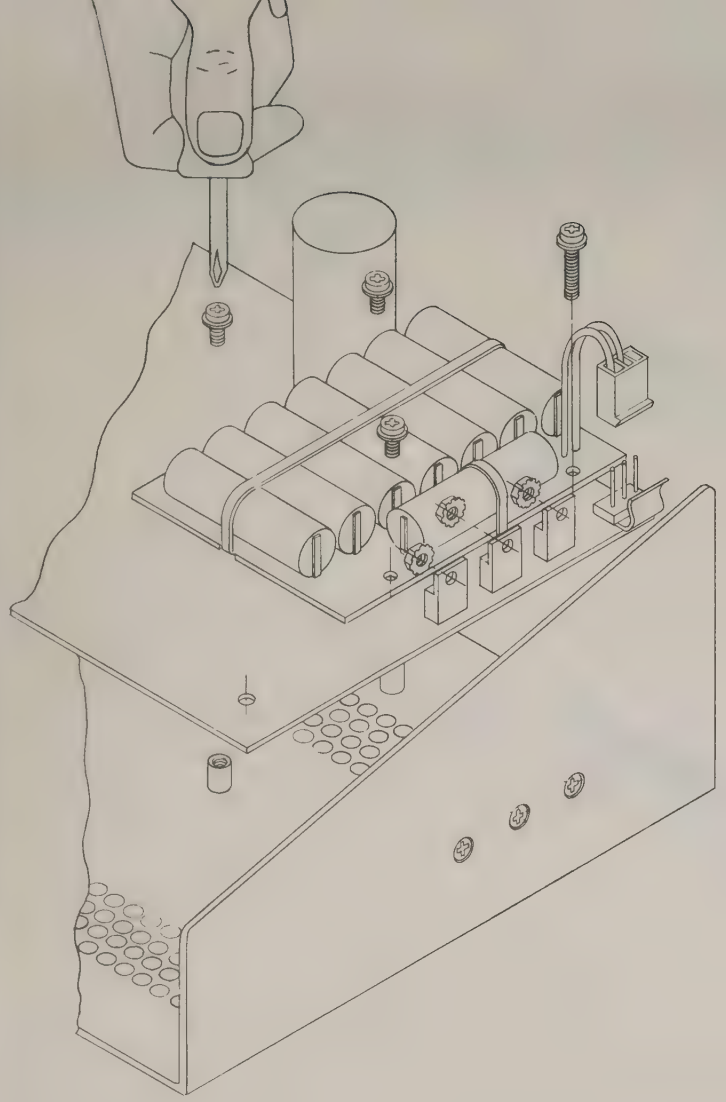
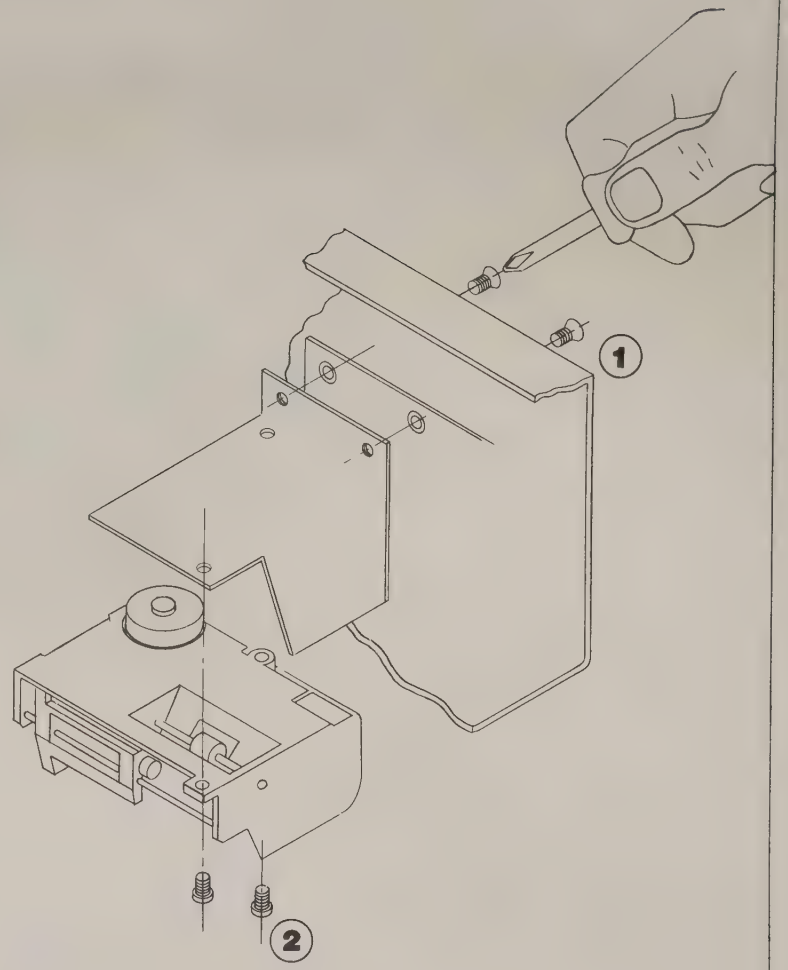
APPLICATION		DO NOT SCALE DRAWING			

BISHOP GRAPHICS, INC.
RICHARDSON, TEXAS





		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES ± XX ± ° XXX ±	CONTRACT NO.	BMI BASIC MEASURING INSTRUMENTS	
			APPROVALS / DATE	ILLUSTRATION BATTERY PACK & PRINTER REMOVAL	
			DRAWN G.P.S. 3-13-84		
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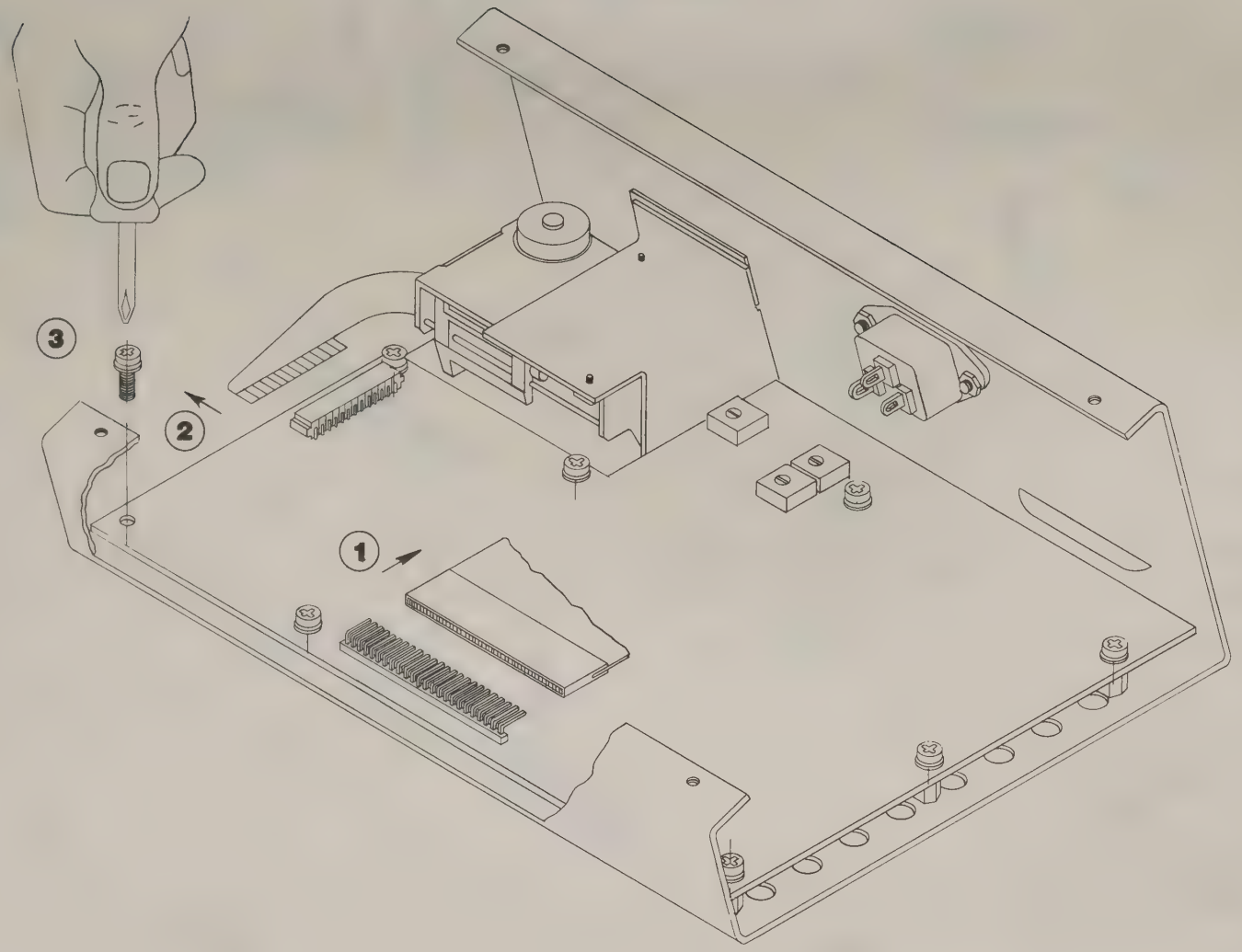
		FINISH		SIZE C / CODE IDENT NO / DRAWING NO 86001132 / REV. A	
NEXT ASSY	USED ON				
APPLICATION		DO NOT SCALE DRAWING		SCALE 1 TO 1 / SHEET 1 OF 1	

BISHOP GRAPHICS, INC. REORDER NO. 1850



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		FRACTIONS DECIMALS ANGLES ± XX ± ° XXX ±	APPROVALS / DRAWN G.P.S.	DATE 3-13-84	ILLUSTRATION DIGITAL BD. REMOVAL GS-2X
		MATERIAL	CHECKED		SIZE C / CODE IDENT NO / DRAWING NO 86001128 / REL. B
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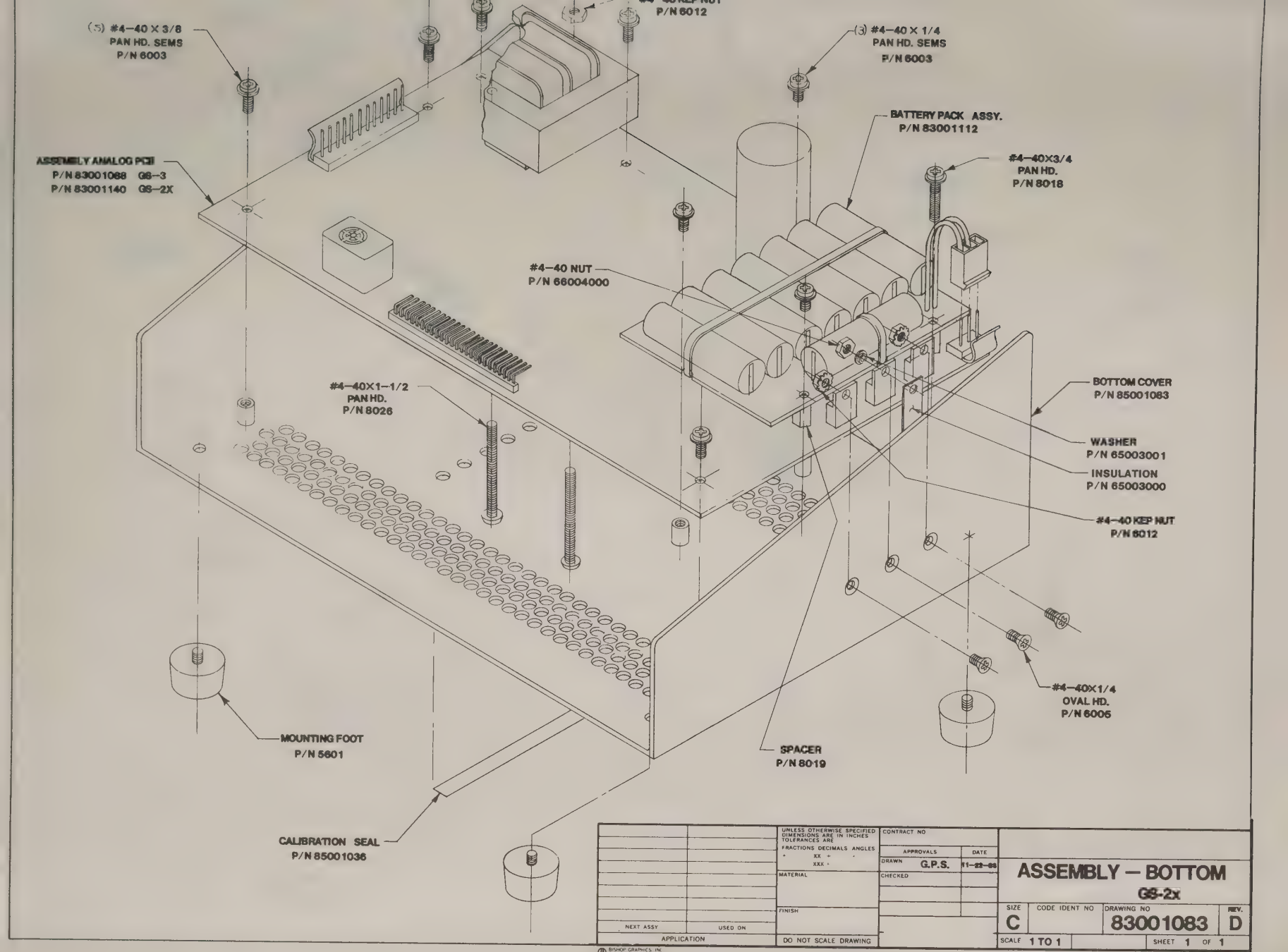
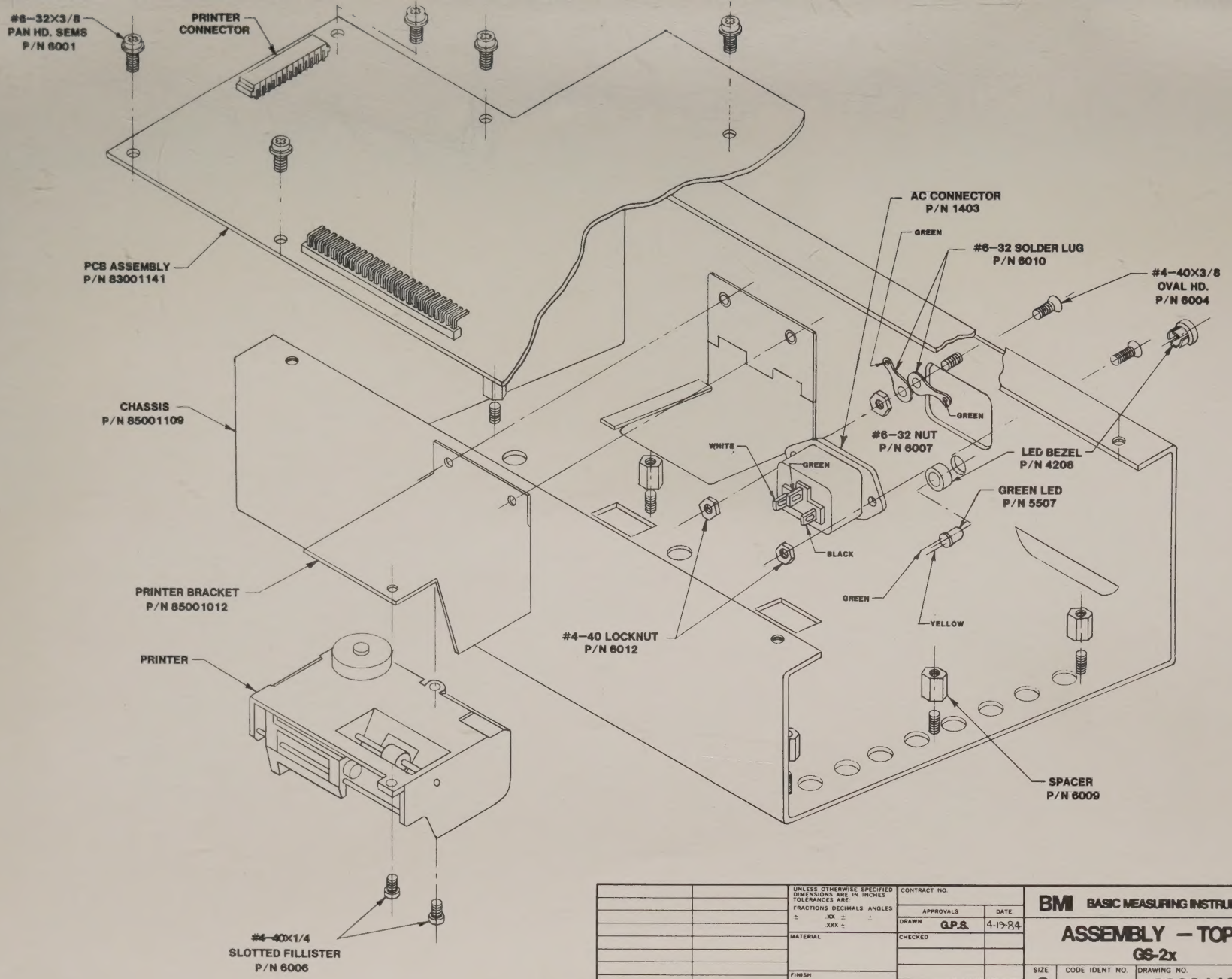
NEXT ASSY	USED ON				
APPLICATION		DO NOT SCALE DRAWING			

BISHOP GRAPHICS, Inc. REORDER NO. 1850



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX ± .XXX ±	CONTRACT NO		ASSEMBLY – BOTTOM GS-2x	
	APPROVALS	DATE		
	DRAWN G.P.S.	11-22-88		
MATERIAL	CHECKED			
FINISH			SIZE C	CODE IDENT NO
NEXT ASSY / USED ON			DRAWING NO 83001083	REV. D
APPLICATION	DO NOT SCALE DRAWING		SCALE 1 TO 1	SHEET 1 OF 1

BISHOP GRAPHICS, INC
REORDER NO. 1850



		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .XX ± ° .XXX ±	CONTRACT NO.	BMI BASIC MEASURING INSTRUMENTS	
			APPROVALS / DATE	ASSEMBLY — TOP	
			DRAWN G.P.S. 4-19-84	GS-2x	
		MATERIAL	CHECKED	SIZE C / CODE IDENT NO. / DRAWING NO. 83001109 / REV. A	
		FINISH		SCALE 1 TO 1 / SHEET 1 OF 1	
NEXT ASSY	USED ON				
APPLICATION		DO NOT SCALE DRAWING			

BISHOP GRAPHICS, INC.
REORDER NO. 1850